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JAPAN REPORT

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CONTENTS

WORLD POSITION OF JAPAN'S IC INDUSTRY DISCUSSED

Tokyo TSUSAN JANARU in Japanese Feb 82 pp 16-28

[Special report: "Industries of the World--Electronic Equipment": Roundtable discussion by Atsuyoshi Ouchi, vice president of the Nippon Electric Co Ltd; Yoshitaka Tsutsumi, commentator of the Nihon Keizai Shimbunsha; and Akie Kataoka, chief of the Electronic Device Section, Electrotechnical Laboratory, MITI; and moderated by Kazuyuki Wakasone, chief of the Electronic Equipment Section, Machinery and Information Industries Bureau, MITI]

> [Text] A discussion was held on various aspects of what Japan's IC industry should accomplish in the future to lead the world, now that it is the frontrunner in the world.

Wakasone: Thank you for your attendance and participation in a discussion on the subject of Japan's IC industry, which has been selected as the fifth topic in the series "Industries of the World."

First of all, as a short overview of Japan's IC industry, in 1980 the production value was 577.2 billion yen, exports 183.3 billion yen and imports 181.9 billion yen, while for the period January to September 1981, the production value was 496.5 billion yen, exports 141.7 billion yen and imports 82.1 billion yen. When compared with the figures for the same period in 1980, the production value in 1981 showed an increase of 21 percent and there was hardly any noticeable fluctuation in exports and imports. In any case, an annual production worth 570 billion yen for an industry surely indicates a standard of respectability.

Although exports of computer-use memory units were favorable last year, with the production of 16 K memory units reaching a peak, it is reported that 64 K memory units will be in full-scale production this year. And based on reports of the development of an IC with high-speed operations as a product of a large project such as supercomputer development, as well as the development of new type semiconductor elements within the System To Develop Technologies as the Foundation for the Next Generation Industries which started last year, although the year 1982 may witness some frustrations, it may also have many rewarding moments.

Today our discussion will be focused on the various aspects of IC. As a start, Mr Kataoka will give a general introduction on the history of IC research and development.

The Stages of IC Technology

Kataoka: The United States was the dominant country in early research on IC technology. The origin of IC technology lies in the invention of transistors in 1948, and the first transistors were based on germanium; therefore, the beginning of the history of today's IC technology is believed to be 1954, when silicon transistors were perfected at Texas Instruments. But the transistors of the early years were not shaped for IC structuring. In 1957 and 1958 Fairchild developed plane technology by forming the transistors in a horizontal direction; in the beginning it was considered a manufacturing technology suited for mass production and there was no thought of its use in connection with IC.

But as the transistors and related components became progressively smaller in size and were used in large quantities in the circuits, the wiring technology became highly complex and the reliability of the packaging and soldering became a problem. Out of the need to solve the tangible problem of the wiring technology, Texas Instruments developed the technology to incorporate germanium into semiconductors by using the mesa structure and cutting technology. Just about the same time, Fairchild developed the technology of having the various components designed for structuring within semiconductors, employing the technique of the plane technology on the silicon. These events occurred around 1959, and it is generally thought that they form the basis of what is known today as IC. Therefore, it can be safely said that today's IC technology was born out of the necessity to simplify the wiring complexity and to improve its reliability. Truly, technologies are born of necessity. As regards this IC technology, the technological developments in the United States were undertaken with huge federal appropriations, principally by NASA and the military in the early 1960's, and as a result lively movement occurred among the various civilian companies as to the applications of the IC technology in the industrial world. In Japan, IC using germanium was perfected at the Electrotechnical Laboratory in 1961.

After that, the MOS-type semiconductor element, which had an insulating layer and a metal cover, in contrast to the bipolar transistors used previously, appeared in the early 1960's. Then RCA announced its MOS IC in 1962 and with it IC technology advanced into LSI.

The semiconductor technology flourished in the latter half of the 1960's and many companies, like Intel and Mostek, mushroomed throughout the United States. Industrial competition in the mastery of the LSI developed spiritedly from the latter half of the 1960's up to the 1970's, an era full of activities. Then upon entering the 1970's, LSI reached full-scale proportions with the adoption of the ion-implantation technology, and further on, technological developments in VLSI were undertaken throughout the world starting in the second half of the 1970's. In a nutshell, this is a stage-by-stage description of IC technology.

The Course of Japan's IC Industry

Wakasone: Back around 1958, when translating U.S. publications, I was troubled for want of a suitable translation for the frequently appearing term "integrated circuit." I translated it as "assembled circuit" after much anguish, but later, upon returning to Japan after spending a year in the United States, I was astonished at the precise terminology for "integrated circuit."

There have been spectacular developments in the progress of IC since then, but I believe considerable hardships were encountered in its industrialization. According to the ranking of a foreign magazine, the Nippon Electric Co Ltd today ranks as the world's second largest IC company, next to Texas Instruments. Mr Ouchi will give us the history of IC industrialization.

Ouchi: I shall present the history of IC industrialization with emphasis on Japan. The conversion of IC into consumer products in the United States began around 1961 and 1962, but for 2 or 3 years after that, the bulk of the goods was supplied to NASA and the military. On the other hand, without any consumer as large as NASA or the U.S. military, the conversion of IC into consumer products began around 1965 and 1966. In 1966 when I was appointed director of the IC Design Headquarters, which Nippon Electric Co Ltd established for the first time, I thought it was about time something should be made for consumption in Japan, and I believe all the other firms had the same view.

But with a discipline of this sort, where the progress is highly competitive, a lag of 3 or 4 years behind the United States in the conversion into consumer products meant a fairly large gap. A few years back, a representative of the British research company MacIntosh made the following remark: "America's excessive subsidization of industries with government appropriations during the early stages of IC development caused a strain, as related to industrialization, in the free competition among industries of the free world. For this reason, independently the various industries of Europe cannot compete against America, which has consistently maintained its dominance since then. The governments of the European countries must offer more assistance to industries." But it was in this manner, with the United States taking the lead, that the world's IC industry got its start.

In the beginning, when practical application started in Japan in 1965 and 1966, we were limited to using it here and there within the company for computer use, but about that time the Nippon Telegraph and Telephone Public Corporation decided on the trial manufacture of an electronic switchboard with IC. Our assistance in the project was the first step in our firm's engaging in limited mass production. Again, the Nippon Electric Co Ltd, in joint research with Sharp Corporation, with Nippon Electric Co Ltd in charge of IC, completed the world's first electronic console using MOS IC in 1966. This became the first step in Japan's electronic console gaining supremacy over the rest of the world, and for Japan to become so strong as to cause trade friction with the MOS memory unit is attributable to the proficient MOS IC being added on by Japan's electronic console manufacturers.

In this manner, IC manufacturers and electronic console manufacturers in Japan worked together and got off to a very good start, but the honeymoon period did not last long. In 1968 and 1969, the United States made MOS LSI for electronic console use and began exporting them to Japan. The various electronic console manufacturers in Japan tied up individually with U.S. LSI manufacturers on a one-to-one basis, and for awhile, Japan's IC manufacturers were in a state of surrender. During that period, IC was still not noted on the list of liberalized trade items, and because LSI could not be produced in Japan, its importation had to be recognized.

This sort of drastic change brought about a strong sense of crisis for awhile, but because the Japanese are industrious and try their hardest, their technologies gradually improved. And within a few years, it reached the point where it was said that Japan's LSI were of better quality. Moreover, by using U.S.-made LSI of poor quality and having inferior products piled up in the electronic console, the situation of no compensation unless specified by the contract continued, and the electronic console manufacturers who had tied up on a one-to-one basis with the U.S. LSI manufacturers unanimously expressed dissatisfaction and simultaneously began to switch to Japanese manufacturers. This was around 1972. And as drastic as it was to be overwhelmed by U.S. LSI, it was equally drastic when Japanese technology rolled back. The fact is that the technology during this period continued on to today's MOS memory units. IC liberalization occurred around 1963. We wondered what would happen if, after being pressured by the U.S. LSI manufacturers in the electronic console market, liberalization occurred. Well, thanks to liberalization Japan's IC industry became stronger. From that time up to the present, a number of severe changes have affected the IC and applied equipment markets. For instance, a transceiver boom occurred just before and after the first oil shock, and there was a time when manufacturing IC only for transceivers was profitable, but the boom went out like a light, leaving both transceiver and IC manufacturers stranded.

After going through these experiences, the microcomputer finally appeared. Microcomputers were first put on the market by the Intel Company of the United States in 1971, and Nippon Electric Co Ltd had its product on the market 2 years later. The present state of affairs is that the microcomputer, along with the memory unit, nay, more than the memory unit, is the driving force of LSI.

The United States traversed almost the same course, but unlike Japan, which progressed with MOS as its principal strength, probably because of the strong influence exerted by NASA and the military, it progressed with bipolar IC as its principal strength. Apart from the MacIntosh remarks, Europe, probably because it was later in recognizing the importance of IC than the United States and Japan, is roughly behind by about 3 years, and the present state of affairs is one of frantic activity, having only recently realized the importance of IC. From the standpoint of industrialization, the socialist countries are believed to be behind the Western European countries by a few years.

Wakasone: The situation in the world was touched upon briefly, but, although a keen competition exists between the United States and Japan, very little is

known about Europe. Can you describe the competitive power among the United States, Japan and Western Europe, and Japan's position relative to the other others?

Ouchi: Generally speaking, as to the ratio of the demand for IC, if Japan is 1, then Western Europe would also be 1 and the United States 2. However, there is a difference in production shares, and the United States controls 60 plus percent of the world's production shares. In the case of Japan, the bulk of some of the export surplus items is directed at Southeast Asia, and because the shares are considered to be practically self-sufficient, the fact is that Europe is being curbed by the United States.

The major portion of IC made in the EC are products from factories of U.S.-affiliated companies, such as Motorola and Texas Instruments in Europe. The present situation is that the large, native European manufacturers, such as Siemens in Germany and Phillips in the Netherlands, are being stymied a great deal.

The Present State of U.S.-Japan Semiconductor Friction

Wakasone: As soon as Japan's IC industry began exporting to the United States after being smoothly nurtured, the press sensationalized the issue of U.S.-Japan friction in semiconductors. This controversy is believed to have started around 1977, but last year the early reduction of duty on semiconductors was mutually agreed upon between the United States and Japan, and for the present it has been settled at 4.2 percent for Japan and 4.24 percent for the United States as of April of this year, but 4.2 percent for the United States also beginning 1 January 1983. The duty rate is still 17 percent for the EC, but by early reduction of the final objective in a swift move at the Tokyo meeting, the United States and Japan will become the most liberal semiconductor markets in the world. Mr Tsutsumi will review these recent developments and furnish a journalist's view.

Tsutsumi: In a broad sense, the U.S.-Japan semiconductor friction is part of the U.S.-Japan trade friction. The latter began with comparatively low-level industrial commodities, such as Western cooking utensils, cotton fabrics and miscellaneous items, but then the scene shifted to such leading industrial goods as steel, home electrical appliances and automobiles, and finally it burst into semiconductors, which is one of the advanced items that America had utmost confidence in. I believe that there is a symbolic meaning. That is, there is evidence that Japan's technological prowess and industrial strength are internationally strong to that extent, but in America about 40 companies, principally in the Silicon Valley, organized the Silicon Industries Association [SIA] to launch a vigorous lobbying campaign in Washington, D.C. Although there has been a lull in their activities recently, I believe that this sort of lobbying will assume an accelerated pace hereafter.

Heretofore the problem has been strictly for Silicon Valley. Basically the SIA is an organization of small and medium enterprises which compare unfavorably with Japanese manufacturers in marketing and other fields, and such

major companies at TI and IBM are not members. But recently, it is reported that the operations at TI, with annual sales of $4 billion and a favorable semiconductor set up, are not moving very smoothly and that IBM's growth, as compared with the past, has stopped, which means that in the future the strongest possibility exists of a huge anti-Japanese movement not only by Silicon Valley on the West Coast, but also by Silicon Plain in the South, the Silicon Belt on the East Coast and even engulfing Europe. Because the lobbying campaign is being vigorously launched to focus on two points--the first being that the United States has begun to lag behind Japan in the sophisticated technology which had been its pride, and second that the problem involves national defense--it is thought that the possibility exists of this voice of protest becoming louder.

Another thing is the underlying reason for SIA conducting an active lobbying campaign. The fact is that the semiconductor manufacturers in America, in contrast to those in Japan, are small or medium enterprises which are separate from the mainframe manufacturers, who, because they handle the finished product, realize a reasonable profit, whereas the semiconductor manufacturers make only a small profit. On this point, the Japanese manufacturer is versatile, making home electrical appliances, generators, communications equipment as well as computers. Because it operates under one large roof as an integrated enterprise, the results of its technological development can be beneficially utilized in the various departments, thereby having an overwhelming advantage when compared with the U.S. semiconductor manufacturer.

Also, quality management in the United States is not necessarily good. This is possibly related to munitions, for in America the premise in quality management is to increase costs, whereas in Japan it is to lower costs. Trading provisions, such as duties, are definitely equal, and if Japan becomes stronger in a state of equality, surely America will not stay still. Especially since Silicon Valley is in President Reagan's home state of California, it is believed that the trend of the future cannot be optimistic.

Industrial Strategy of U.S. and Japanese IC Manufacturers

Wakasone: Even though classified as semiconductor manufacturers, conditions differ between the large companies and small and medium enterprises, but recently U.S. semiconductor manufacturers have moved into Japan. This sort of involved business relationship of U.S. manufacturers expanding in Japan and of Japanese manufacturers branching out in the United States is believed to be a desirable one in various ways, and we welcome this sort of arrangement. Mr Ouchi will speak on management strategies of U.S. and Japanese industries.

Ouchi: Mr Tsutsumi sounded extremely apprehensive but because I am by nature an optimist or probably because my wish is that things must fall in proper place, I think on the contrary that events are moving in the desired direction. It is a fact that one of the problems, from the standpoint of management strategy, was that heretofore Japan had integrated manufacturers whereas the United States had small and medium enterprises which specialized in IC manufacture. However, as for the independent small and medium manufacturers in Silicon Valley, the Nippon Electric Co Ltd bought out one of

them, some were absorbed by Siemens and Phillips, others were successively integrated into large American companies, and in terms of scale, they have gradually begun to resemble Japanese companies. It is thought that these changes will become a factor in solving the friction problem.

Another thing is that it has been said all along that, heretofore, Japan was a step ahead of the United States with respect to production technology for quality products at inexpensive cost, but when compared with the United States, Japan is weak in the area of basic development; on the other hand, the United States is strong in the area of basic development but poor in quality management and production technology. But in recent years, management in America has begun to place great emphasis on quality control. As an example, at a seminar sponsored in Washington, D.C., by the Electronic Industries Association of Japan in 1980, a section chief of Hewlett-Packard Co, which is an American IC user, ranked the quality and reliability of both U.S. and Japan-made IC used by his company, and at that time the top three were Japanese manufacturers and the bottom three were U.S. manufacturers. Moreover, the rate of defective IC's was reported to be different by several times. However, a year later, that is, last year, the same section chief reported at the seminar in Washington, D.C., that "U.S. manufacturers are among the top three and the gap has been reduced."

The United States did not attach importance to quality management of general consumer goods because previously it had been confident of being unrivaled throughout the world and because it had huge purchasing agencies such as the military and NASA, but faced with the Japanese offensive, it had to think again. Because it has wrought such changes in just a year and, above all, because it is a country of strength and wealth means that Japan cannot be complacent, relying on quality and other factors.

On the other hand, Japan used to be considered weak in research and development, but in recent years, the activities of the Japanese have become prominent, with outstanding patents and favorable theses submitted at international scientific gatherings. This was because after the war, the smart Japanese brains were occupied in catching up, leaving no time to develop their originality, but today when they have caught up and overtaken in the state of manufacturing, it can be said that finally they have begun to have the time to develop their originality. In this respect, it is a fact that Japan is about to draw close to the United States. Thus, the patterns of technology of the United States and Japan have become similar.

From another aspect, it has been said that American management executives cannot invest in facilities from a long-range viewpoint because they are accountable for achievements in a short period; however, recently, such has not been the case with IC. Also a mood to absorb the virtues of Japanese-type management, and not only with regard to IC, has spread among some American management executives.

Furthermore, while the IC industries in the United States and Japan are getting to resemble each other in many respects, already extensions in the IC industry have begun, unlike the automobile industry. Not only Nippon

Co Ltd, but Toshiba Corporation, Hitachi Ltd and Fujitsu Ltd already have plants in the United States, and Nippon Electric Co Ltd has begun construction of its second plant. Heretofore, only TI from America has had a plant in Japan, but recently Motorola and Intel have made inroads in Japan. If this sort of mutual extension becomes increasingly active, difficulties will arise in the interpretation of trade balances; before this sort of dilemma is reached, if precautions are taken so as to avoid occurrences such as the 10-year TV war when Japanese manufacturers were subjected to dumping suits, the situation should be smooth beyond expectation. I hope things will move in that direction.

Wakasone: As for IC trade with the United States, Japan had an unfavorable balance of trade in 1979, but there was a slight favorable balance of trade in 1980. However, for the period January to September 1981, as a result of the above described mutual extension, a very desirable state was achieved with a near balance of 49.6 billion yen in exports and 48.9 billion yen in imports. It is considered that it would be a good thing to dissolve the friction starting from this point.

The Hard Lesson From the 10-Year TV War

Wakasone: As for the memory unit for computer use as described in the opening paragraph, the 64 K reportedly will be in full-scale production in 1982, but recently newspapers have given prominent coverage to reports such as Company A being prepared for a monthly shipment of 300,000 units or of Company B being prepared for a monthly production of a million units. A great many people appear to be concerned about overproduction. What is the state of affairs?

Ouchi: The 64 K will probably become the top IC memory unit, at the earliest, after the middle of this year. At the present stage, the various computer manufacturers, which are the largest users of the 64 K throughout the world, are evaluating the trial manufacture of memory systems using the 64 K. The reports in the various newspapers contain wishful surveys on demand by the various manufacturers; it is believed that with this type of new product, since the cost gets cheaper as the running curve rises, after a share is first secured, most of the figures are based on a wish to get as big a share as possible. Doesn't the total of such figures exceed the demand of the world? Since the various manufacturers are not expected to undergo a loss with huge unmarketable inventory, for the present they are expressing a hope, but actually things will settle down on the basis of the supply-demand balance.

Quite a bit of publicity has been given to reports that Japanese companies have already garnered 80 percent of the U.S. market with the 64 K, etc., but this is based on the sample stage talks and by no means does it concern a firm situation for the future. To be sure, America is late in its recovery, but recently the yield of American manufacturers has increased and therefore it is believed that things will not reach the danger point.

Wakasone: Because Japan has waged fierce competition, the price problem is a matter of concern. We are extremely fearful of any misunderstanding

regarding price by foreign countries. Of course, there will be no dumping, but if a rock-bottom offer is made after careful operational calculations, immediately the possibility exists of a dumping accusation that can occur not only with regard to IC but in any field. Even if cleared of the accusation in the end, even one such action would cost a lot of money and time; so I think that the important thing is to avoid being the object of suspicion, and certainly the various companies are fully aware of this point.

Ouchi: Japanese semiconductor manufacturers are also engaged in TV manufacturing, so they all had the painful experience of the TV dumping suit that lasted for 10 years. Although they were cleared in the end, as Mr Wakasone mentioned, when loss of trust, loss of business opportunities and lawyers' fees during the period are considered, an enormous loss is incurred, and although the problem is faced by the manufacturers individually, I think that the Japanese manufacturers all have sound judgment.

However, difficult problems arise from the new trade laws, such as the unacceptability of the selling price in the United States today being the same as the selling price in Tokyo today. If the price after deducting warehouse stock costs by the marketing company in America is cheaper than the price in Japan, the ruling is dumping. This is a stiff restriction on such goods as IC, which is subject to a fast drop in prices. But since laws are made to be obeyed, I have always said that "there's no need to sell if the risk is the danger of dumping, because markets exist not only in America." I think that other manufacturers are also heeding this point.

New Frontiers Out of U.S.-Japan Cooperation

Wakasone: Mr Tsutsumi, do you have any other matters to discuss regarding semiconductors as pertains to the U.S.-Japan relationship?

Tsutsumi: It is true that semiconductors are components and not final products, and therefore the nature of their friction is different from that of automobiles, TV, etc., and recently their mutual extension has progressed, which is a desired trend. However, as stated previously, optimism cannot prevail, for even a giant company like TI can meet a crisis, which means that the need exists for a thorough accounting.

Then there's the matter of concern about the honesty of the workers. At a firm called Monolithic Memory Co, 500,000 units of chips were stolen despite locked warehouses with electronic guarding devices trained on them. Theft has occurred twice in 1 year at this firm, and the same type of theft occurs throughout Silicon Valley. It is rumored that the final destination of the stolen chips, via Germany, was the Soviet Union for use on the MIG-25, and the difference in honesty between workers in the United States and Japan, which already shows a marked difference, may increasingly widen. This is not simply a trade problem, but it has become a national defense problem, and so it behooves Japan to be mindful of this matter.

My biggest concern is the fact that equal footing does not necessarily mean equal partnership. Even if the same provisions are applied, a sense

of danger will be stirred up, especially if the United States cannot match Japan, and on this standpoint the semiconductor will serve as a genuine symbolic item that takes into consideration the relationships of trade, technology and friendship between the United States and Japan. The present semiconductor market is somewhat limited and friction can easily occur. Pioneering for end use production requires investments in plant and equipment, but it behooves the United States and Japan to cooperate in developing new markets, new frontiers and new products.

Ouchi: My optimistic views, mentioned previously, are based on the ample room for the creation of new markets, at least to the end of this century, for IC, which has been exploited especially by the frontrunning microcomputer, etc. If the emphasis on competition is placed on the creation of new areas for demand and not on fixed areas for demand, then it is considered that peaceful coexistence is possible.

But my optimism, as mentioned previously, is wishful optimism, and as Mr Tsutsumi remarked, danger definitely exists. A high-ranking official of the U.S. Department of Defense remarked: "The military order of the Western camp has been maintained only because of the preservation of absolute domination by the Western camp based on America's IC and computer. The fact of IC technology of Japan or Europe reaching the same level as that of the United States, from the standpoint of national defense, poses an alarming problem."

Confronted with that sort of thinking, the manufacturer has no recourse at all. In such a situation we would have to ask for government intervention.

Why the VLSI Project Was Successful

Wakasone: This means that consideration must be given to various aspects. At this point let us change the topic to a technological development keyed to the future. By nature, joint research is an extremely difficult accomplishment, but an example of great success is that of the VLSI project. Mr Kataoka will describe the aims of the VLSI project, the achievements and a followup on the various companies.

Kataoka: Previously there was some discussion critical of Japanese originality relative to industrial activities of the United States and Japan, but in reviewing recent trends, granted that the start of technology was furnished by America, I believe that the reason for the Japanese being equipped with such technological knowhow is because they have developed their originality in various ways in delicate areas, and the product is reflected in their industrial activities. The Japanese technologists were equipped with qualities over and above those possessed by merely an excellent student, and this led to the success of the joint research on VLSI that became a model accomplishment.

The origin of this joint research was the knowledge that semiconductor equipment with an extremely microscopic structure was probably used in the future system computer of IBM and the urgency to establish a microscopic

processing technology in order to deal with the situation. The joint research was undertaken for 4 years starting in 1976, but the big reason for achieving the considerable results probably lay in having the objective of the research narrowed down to focus on the basic technologies, with possibilities for use in the various disciplines. It is believed that the accomplishment was attributable to the many outstanding technologists who concentrated and pooled their resources with a burning desire to develop new disciplines.

Concretely, the objective was an integration of 1 megabit per 1 square cm, and originally it was to establish a microscopic processing technology that could cut 1 micron in size. However, as a result of the 4-year joint efforts of the researchers, numbering about 100 on temporary loan from the Electrotechnical Laboratory and 5 computer companies, first the electronic drawing technology, and then the transferral technology using various methods with electronic lines, optics, X-rays, etc., were established. Even regarding materials, the defects of the silicon after material, curvature of materials and other delicate basic problems were solved.

And because the results could be focused even in the development of various types of semiconductor device manufacturing equipment, the ripple effect was very great and thereafter greater benefits were reaped from the technology, not only by the five participating companies, but by the wide range of industries related to electronics technology. In that respect, it was believed that the achievements of the VLSI joint research would become the potential strength for a wide range of activities for Japan's industrial world. It was thought that this was an example showing that, given a common objective, Japan's technological development power could contribute by lining up in the front rank in the world.

Ouchi: The theme was right and so was the timing. If VLSI had been merely an extension of the optics technology possessed by the various semiconductor manufacturers, the advanced companies would probably have hidden their latest technology, the lagging companies would have attempted to steal from others, and the project would have been surrounded with suspicion. Quite the contrary, just about that time it was learned that the VLSI for use in the future system computer by IBM was not an extension of optics technology but one that probably required the technology of either the electronic beam or soft X-rays. That being the case, a sense of danger pervaded since even Japan's fairly large manufacturers, independently, could not develop such a manufacturing apparatus; moreover, since they were mutually beginning from zero, there was no room for suspicion.

When the young NEC engineers who participated in the joint project were asked for their impressions, they replied: "We were sent with a totally clean slate, and we thought that if our working performance was slower than that of the others, we would bring dishonor to the company by being referred to as NEC's mediocre technologists. We were hyped up." All the employees exerted maximum efforts in this sort of mood. This is probably one of the factors in the success.

Kataoka: From the standpoint of trend and timing in the technologies of the world, adoption of the electronic beam exposure device as the central subject was an accurate one.

Ouchi: Then, too, this is not to flatter MITI officials, but having the group of technologists from the Electrotechnical Laboratory participating and furnishing outstanding and impartial leadership was tremendously effective.

The Direction of Technological Development Hereafter

Wakasone: Recently, Americans and Europeans have shown strong interest in the success of joint research, which is a gathering of industries with competitive status, but it appears that competing while assuming a joint status is a distinctive feature of the Japanese industrial world. In the wake of the VLSI success, the large project on supercomputer development and the new functional element development project, which is a link in the System To Develop Technologies as the Foundation for the Next Generation Industries, were begun last year. Both of them are based on the burning desire to develop new devices. Mr Kataoka will speak on their future direction and on overseas trends of the same type discipline.

Kataoka: As described just now, even with IC technology, technological developments based on new viewpoints have begun. I believe it would not be a mistake to consider IC technology with silicon as the nucleus of the mainstay industry to support Japan's economy hereafter, except that it will not always be true to consider silicon as being almighty. In the field of electronics, it is thought that needs will arise that will make it imperative to use an element other than silicon hereafter.

As a concrete example, several years ago development of a chemical compound semiconductor was started in order to utilize luminous action, which is not possible with silicon, and its technological foundation is about to be established. This afforded an opportunity, for great efforts have been expended for positive utilization on an industrial level of the unique properties of this chemical compound semiconductor, which had drawn attention for some time. A representative example is the ultra-high-speed element. In other words, there are a number of semiconductors, other than silicon, with fast-moving electrons, and in the event the microscopic processing technology using the exposure device with these semiconductors is applied equally, depending on the differences in the material itself, the prospect of a performance far superior to silicon was revealed. One of these semiconductors is a gallium arsenide-related item whose electrons have a speed nearly 10 times faster than silicon, and as the hardware of the large project to develop a high-speed computing system for use in scientific technology which was started this year, it was decided to conduct full-scale R & D on it. Gallium arsenide not only has fast-moving electrons, but it has the advantage of acquiring the insulation material necessary in the assembly of various circuits. The capacitance latent in the insulation, which had been a problem with silicon, can be solved, and the making of a 30 picosecond high-speed element is expected.

Since 3 years ago in America, development of a gallium arsenide IC has been underway under military contract.

In that case, the basic technology for actual application will probably be that of an IC technology adapted from silicon technology or microscopic processing technology, but the problems peculiar to chemical compound semiconductors must be solved.

Also, the Josephson element, which was researched from way back by IBM and others, is theoretically known to move at an extremely fast speed. This is not necessarily an extension of semiconductor technology, but it is believed to open up an entirely new technology field. The Josephson IC is also included in the R & D plan for supercomputers.

The R & D of new dimension semiconductor elements was started by MITI this fiscal year. The R & D of new functional elements was selected from among the projects to develop the foundation for the next generation industries in the establishment of a basic technology which would support industries 10 years hence. These new functional elements are ones which will display new functions hitherto unavailable, and they will be divided into three kinds: the three-dimensional circuit elements, the super grid element and the environment-proof reinforced element.

From the standpoint of microscopic processing technology, heretofore IC technology has always been based on the premise of lining up many small items on a two-dimensional plane, but in seeking future progress, a line of thinking was born for using semiconductors in three-dimensional form. The three-dimensional circuit element, which is included in the System To Develop Technologies as the Foundation for the Next Generation Industries, is a basic project for the skillful realization of a three-dimensional, solid structured semiconductor, and by adding three-dimensional depth to the heretofore two-dimensional semiconductor technology, wouldn't a basically new type of technology be required?

It is believed that with the emergence of these products, the opportunity will be afforded to seek the evolution of new electronics. That is, the objective of a computer is man's brain, and the expression of its efforts is the material realization, but because the anatomy of living things--whether the brain or the sensory functions--always has a three-dimensional structure, some gaps have existed between today's technology and the anatomy of man and other living things. And it is possible that with the establishment of a technology to increase the dimension by one to three-dimensional, these gaps will gradually disappear.

Among the R & D plans is one that seeks a very high state of advancement by cramming the logic structure, or the memory structure in a three-dimensional state, by arranging the IC with a sensor function on the surface, arranging the processing function deep inside to process the output, and with the plan of a three-dimensional intelligent image processor that resembles the sensory function of a living thing. I believe that it can be anticipated that an extremely interesting sophisticated product will result.

As for the microscopic processing technology, since there is the need not only to miniaturize but also to achieve three-dimensional composition, development will be carried out along with a new exposure apparatus or exposure technology consisting of many elements that can be made to have proper high accuracy even if the surface is uneven.

Next, concerning the super lattice element with an advanced technology, not only is it structurally three-dimensional for incorporation, but, as for the material itself, it is believed that ideas will emerge on devising new functions by using material with a three-dimensional structure. Heretofore, making uniform-sized semiconductors was one of the objectives of the technology, but recently a new type of technology has been developed, that of stacking up a different kind of semiconductor with a microscopic structure which is based on optics technology, etc., and achieving unique performances with them. By piling up a different kind of material at intervals of several angstroms to several tens of angstroms, the new property, which hitherto could not be derived from an analysis of the physical properties of a semiconductor, such as an element stressing super high speed, is the super grid element. In this discipline, it is thought that it will become such a technological development that regarding its shape 10 years hence, there is no way of even making a forecast at present.

Heretofore, the prerequisites in the use of silicon were near normal temperature and a quiet environment, but the making of an IC that could be used with assurance even in bad environment is included in the R & D of new functional elements. This is an environment-proof performance even in space filled with strong radiation or in comparatively high-temperature areas, an element which can withstand shock, etc. It is believed that this will be a big boost in market expansion of the future semiconductor IC industry.

In any case, it appears that much of the R & D conducted by Japan thus far has been undertaken with a solid approach to positive objectives that could be fulfilled, but hereafter it is thought that Japan must assume a posture whereby it must contribute to the world through pioneering in new technologies and penetrating unexplored fields. In this R & D system which will last for 10 long years, it is believed that programming basic technologies in order to achieve these new developments will be linked to fulfilling Japan's major role in the technological progress of the world. This is the new course marked for Japan's technological development. We are hopeful of its success.

Technological Developments for Contribution to the World

Wakasone: In order for this huge population to survive in Japan, which has limited resources and energy, the government and the people have exerted efforts together to develop sophisticated technologies for application in industries. Recently, however, in light of Japan's remarkable achievement of success, criticism has been levelled at this joint enterprise of government and the people. This collaboration has been referred to as the high technology problem, or high tech problem for short, and representative

examples of criticism are the speech made by the U.S. trade representative in the Congress, discussions held by OECD committees, etc.

At this point, I would like to remove a misunderstanding as relates to an action in the OECD. Talk has been circulating that Japan is criticized in the recently released paper by the Committee on Positive Adjustment Policy, in which various discussons are held on industrial policies, but the truth is that it is only a discussion report and, moreover, it is not necessarily critical of Japan. In other words, the committee specified three classifications--original technological development, imitative technological development and leapfrog technological development; it is reviewing the advantages and disadvantages occurring with government assistance in each case, and the subject of industrial policies is not directly criticized. West Germany emphasized that technological developments should be entirely left to the market mechanism, while France and Japan, where market mechanism is totally ineffective at the present state, emphasize that government intervention is necessary, and so the present stage is one of discussion on the various points.

As for the other, it is true that a speech directed at Japan was made in the U.S. Congress. At the International Trade Subcommittee of the Joint Senate and House Committee on Economics, the U.S. trade representative stated that the industrial policy "in Japan of government and private companies engaged in joint research, financial subsidies, preferential treatment with taxes," etc., as relates to sophisticated technology disciplines, contributes to the intensification of international competitive power in the field of sophisticated spearhead technologies. He added that because this sort of action can distort international trade in the future, America must consider counteracting measures. But even in the United States, the government is rendering various kinds of assistance, and West Germany, France and Britain, more than Japan, are disbursing huge sums of government subsidies in these disicplines. We cannot help but feel regret at this situation. What are your views on the matter, Mr Tsutsumi?

Tsutsumi: It is true that criticism by the United States and the West European countries lately has become stronger regarding the so-called national projects, that of technological development by government and private company cooperation in Japan, but there is a great deal of misunderstanding. For instance, with the VLSI technological development, which is an example of success considered rare in recent times, of the total expenditure of 70 billion yen, the government's share was no more than 40 percent or 28 billion yen. Of course, industry will pay back the government.

Ouchi: If profitable, it will repay.

Tsutsumi: In comparison, the VHSIC plan, which the United States pursued Japan with, is funded totally by the Department of Defense, even to the extent of buying up the products. From that standpoint, a good many false charges are apparent.

Recently, research investments in Japan have approached the ratio of 6:4, but previously, the pattern was a ratio of about 7:3, with the private sector assuming the greater burden. Moreover, the government's share of 3 was directly used by national universities or by government-related research institutes as grants, and therefore the private companies received very little.

Ouchi: Generally it was about 3 percent of the total investment for R & D by the private companies. The bulk was subsidies from MITI.

Tsutsumi: In the case of the United States, traditionally the government has appropriated more than 60 percent for R & D investments in military technology, space technology, electronics technology, etc. With such an involved historical background, America's accusation that appropriating government funds by Japan is outrageous lacks force.

One thing we should be careful about is that in the United States the government appropriates funds for such government projects as military technology and space development, whereas Japan, which hardly has projects of that sort, spends money on consumer goods used directly by the civilian populace. While assisting even the strong, any success achieved is converted for export purposes. The United States seems to be pointing at this sort of activity and so it is only natural to exert efforts to remove misunderstanding, and even so, there are factors which Japan must ponder over. As one means, recently Japan has been vigorously sponsoring international conferences on computers, optics technology, VLSI, etc., and so at these sites, Japan should seek understanding with comprehensive explanations on Japan's activities and at the same time engage in mutual study by public display internationally of the results. In technology, Japan is a first-rate country and it must assume a posture befitting its rank; otherwise problems will always remain.

Kataoka: I agree heartily. A technology is not something to be monopolized by one company or one country, but I believe it should be used effectively for all mankind. In this respect, what Japan does as technological development that can contribute to the world will greatly assist in solving the various international problems.

Wakasone: Hitherto, Japan had the United States and West European countries as its objective and strived to overtake their standard, but today that gap has decreased or Japan has surpassed them in some disciplines. On the other hand, today the developing countries are striving, with Japan as their objective, and therefore Japan must aim at more sophisticated fields in order to shift industries, and it must take the stance of releasing to the developing countries what it dealt with previously. In that sense, it is believed that Japan ranks with the United States and West Europe to compete in IC, and with its results Japan's promising industry can make a contribution to the world. I shall ask for your knowledge and assistance in the future and now I will close this roundtable discussion. Thank you for your time.

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PRESENT STATE, TASKS OF JAPAN'S SEMICONDUCTOR INDUSTRY

Tokyo TSUSHIN JANARU in Japanese Feb 82 pp 29-33

[Special report: "Industries of the World--Electronic Equipment": Article by Hideji Sugiyama of the Electronic Equipment Section, Machinery and Information Industries Bureau, MITI]

[Text] A review is made of the progress thus far reached by Japan's semiconductor industry, which produces one-fourth of the world demand, and an insight into future tasks is given.

The Beginning

Electrically a semiconductor is a solid substance that is placed midway between a good conductor, usually metallic, and an insulator made of either rubber or glass, and it has the unique characteristic of functioning either as a good conductor or an insulator, depending on its status. In 1948 Shockley, Bardeen and Brattain of Bell Laboratories developed the world's first semiconductor transistor by utilizing this characteristic.

Prior to the discovery of the transistor, there was the vacuum tube, within which was incorporated a heat source which released electrons, but the vacuum tube was plagued by a number of substantial problems, such as a high consumption of electrical power, poor structuring, difficulty in miniaturization and generation of a large amount of heat. Because it was possible to solve these problems at one stroke with the advent of the semiconductor transistor, the ripple effect it created was so great that the progress of electronics is said to have started here.

After the discovery by Shockley et al, remarkable progress was achieved in semiconductor R & D, and various elements possessing successively higher performance and greater reliability were developed, but the event that made the greatest impact on the electronic industry of today was the invention of the integrated circuit (IC) by Kilby in 1958. The IC is structured with many elements placed on top of a small plate, and it was epoch-making in realizing the miniaturization and high performance of electronic equipment. Computer progress today would not be possible without the IC. Recently a variety of commodities have been produced through

its integration with machines, and it is the central item in the so-called conversion to mechatronics.

The Present State of Japan's Semiconductor Industry

The value of Japan's semiconductor production in 1980 was recorded as 864.1 billion yen, a 36-percent increase over that of the previous year, and it represented one-fourth of the world demand. Of the total, 293.8 billion yen was for single conductors, such as diodes and transistors, and 570.3 billion yen was for IC. The growth rate was 16 percent for single conductors and 50 percent IC.

This sort of tremendous growth of IC has been a consistent trend recently, and one reason for this is the increase in its use in new products. A truly wide range in application has resulted, such as watches and electronic consoles, it goes without saying; office appliances and equipment such as office computers, facsimile and word processors; home electrical appliances such as electronic ranges and air conditioners; adaptations with industrial equipment such as robots and measuring equipment.

According to the shipping information classifying use of the IC in 1980, 40 percent was for civilian consumer goods and 31 percent for industrial use. A large percentage of the civilian consumer goods is accounted for by such items as audio equipment, watches and electronic consoles, 12 percent each of the total exports; and TV and VTR, 10 percent each.

On the other hand, for industrial use, computers accounted for a comparatively large share, with 11 percent, and the rest was for a wide variety of goods.

The second reason for the growth of IC production lies in the increase of exports. The value of IC exports in 1980 was 183.3 billion yen, which was an increase of 69 percent over that of the previous year and accounted for more than 30 percent of the total IC production. Classification by destination showed 41 percent to North America, 20 percent to Europe and 39 percent to Southeast Asia. The principal exports to North America and Europe were MOS memory units, and those to Southeast Asia were MOS logic for electronic consoles and watches, and bipolar linear IC for household appliances.

Regarding IC, it must be noted that Japan's imports are also large. This is because Japan's IC market has expanded rapidly along with the progress of the various user industries, development of new elements by the United States as the leading nation in IC technology, etc. The value of IC imports in 1980 totalled 108.9 million yen, or about one-fourth of Japan's domestic market. In comparison with exports, there was an excess of imports until 1978; in the case of North America, which accounted for 65 percent of the imports, there was an excess of imports until 1979, then an excess of exports in 1980, but the situation is fairly balanced at present.

The History and Policies of Japan's Semiconductor Industry

The history of Japan's semiconductor industry, as with most of the other industries, began with the importation of technology from the United States. With the continued importation of basic patents from Texas Instruments, Fairchild, Intel, etc., investment of huge development funds and employment of highly qualified personnel, Japan achieved its present ranking of being abreast with the United States. Because the IC mass-production plants in Japan are greatly concentrated on the island of Kyushu, it is recognized worldwide as Silicon Island, one of the three largest semiconductor manufacturing regions in the world, along with California's Silicon Valley and Texas' Silicon Plain.

IC is divided into two categories, the bipolar type and the MOS type. Historically, the bipolar type was developed ahead of the MOS type and the former had the advantage of a faster operational speed than the latter, so for these reasons the U.S. companies undertook vigorous development of it. A wide gap in technological differences existed between the United States and Japan in this field. For this reason, Japan's IC manufacturers targeted the MOS type, which is slightly slower in operational speed but suited structurally for mass production, besides having lower power consumption, and they energetically engaged in its development. As a result, Japan grew until it led the world in this field, and it has developed MOS IC factories to produce a wide range of products, from watches and electronic consoles to computer-use memory units, etc.

But the history of this development was by no means smooth. Because it was one of the more sophisticated technologies in electronics, IC possessed a number of special characteristics not seen elsewhere, and extremely severe restrictive conditions arose when civilian enterprises engaged in the development and production of IC regarding these characteristics.

First of all, huge sums of money are required for R & D investment. IC became known as the core of industries because its field of use is multifaceted, and various demands have been made from the standpoint of higher integration, greater speed, lower power costs, etc.; in order to win markets with these achievements, it is imperative to ceaselessly conceive technological innovations. For this reason, R & D investments account for about 15 percent, which is a very high percentage, of the total IC sales.

Second, the semiconductor industry is an equipment industry which requires an enormous amount of investment in facilities. Many costly machines are needed, especially in IC production, and even in production facilities corresponding replacements are required because of the pace of technological innovations. For this reason, investments in facilities account for about 20 percent of the total IC sales.

Third, the sharp decline in prices can be cited. Differences exist due to the variety of goods, but generally speaking, because the principle of

the proficiency curve can be applied to IC, a lower cost can be achieved by raising the cumulative production amount and using strategy to survive the competition. But even if large funds are invested resulting in development of a new type element, as soon as the product appears on the market, the price takes a sudden dip, and as a general rule, the total sum does not increase as much as the volume.

Fourth, the life cycle of the products is short. Because of the intense competition for development, as described above, in those fields where large markets are anticipated, such as for computer-use memory units, the life cycle is short because new products are successively produced. A typical example is the RAM (random access memory), in which the series of products moved up successively from a kilobit (a bit is a unit of information quantity, derived from binary digit), 4 kilobits and 16 kilobits, each with a life cycle of about 4 years, and the presently surging 64 kilobit product will probably last 4 years or less. Thus, because the tendency has been for the mainstay products which required large development costs and investment in facilities to have a short life cycle, it must be said that the financial load shouldered by private enterprises has been extremely heavy.

As described above, the semiconductor industry is an important industry that supports the foundation of Japan's industries, and because private enterprises, in particular, have shouldered the heavy burden of both capital and human resources, the government has implemented various policies in order to aid their promotion.

In line with ranking semiconductors as an essential industry and to determine its future course of action, the semiconductor industry was included in such action as the furnishing of low-interest loans for investment in facilities, as well as in such legislation as the Law on Temporary Measures To Promote Electronics Industries in 1957, the Law on Temporary Measures for Specified Electronics Industries and Specified Machinery Industries in 1971, and the Law on Temporary Measures To Promote Specified Machinery and Information Industries in 1978.

From the standpoint of technical development, it is one of the industries listed to receive assistance in the sustem to subsidize R & D expenditures in essential technologies, and assistance is also rendered as a computer-related industry. In concrete terms, in order to deal with the liberalization of computer imports and capital, the system to subsidize promotional expenditures to develop electronic computer and related industries was implemented from 1972 to 1976, and subsidies for IC development were granted in 1973 and 1974. During the 4-year period from 1976 to 1979, the subsidies granted for the technological development of VLSI for use in the fourth generation computer led by a joint research team of the five major companies achieved tremendous results, and high praise has been lavished at home and abroad. Following this, within the development of a high-speed computer system for scientific technological use which began in FY-81, developments have been underway on HEMT using gallium arsenide and on the new high-speed logical element called Josephson's element, from which excellent results are anticipated.

In addition, the system for R & D of technologies as the foundation for the next generation industries inaugurated in FY-81 with the aim of establishing the industrial base technologies of the 1990's has as goals the development of a super grid element, a three-dimensional circuit element and an environment-proof reinforced element; the emergence of totally new original elements is anticipated.

IC and International Relations

As for international relations, various measures were carried out in order to secure the domestic market in the infant stage of Japan's semiconductor industry, but today the importation of foreign capital and technology, as well as other matters, have been liberalized so that the domestic market is left open. Sensitive areas exist in international relations regarding IC, but basically, especially with the United States, it is believed that there is no basis for trade friction problems.

Regarding the interchange of technology and capital, a spirited interchange internationally is seen in the various fields of the semiconductor industry. In the beginning, technological interchange began with a one-sided importation by Japan, but along with Japan gaining technological power, its contributions increased and today a cross-license system exists, principally between the United States and Japan; with the mutual use of technologies, a higher order of R & D and smooth production operations are realized.

Even with the interchange of capital, Japan's major semiconductor manufacturers are actively involved in overseas investments; they have not only established market bases in the United States, Europe and Southeast Asia, but they have also constructed production bases. For this, they have employed local labor in the manufacturing and other functions, and they have made a large contribution to the host countries with their installations. On the other hand, foreign enterprises have accomplished a great deal in advancing into Japan by way of acquiring Japanese markets, utilizing stable Japanese labor, etc., and among them is Texas Instruments, the world's largest semiconductor manufacturer, which has established four factories in Japan with excellent performances in the manufacture of sophisticated products. Thus, a vigorous interchange of technology and capital is being undertaken internationally in the semiconductor industry, and it can be said that from the standpoint of international cooperation, Japan is playing a leading role.

But even with this sort of environment, it was not possible to avert trade friction with a sophisticated technology discipline such as the semiconductor. As for the trade balance in semiconductors between the United States and Japan, until recently Japan had an excess of imports, but today it is almost a balanced situation. Overall it has progressed up to now without problems, but regarding the classification by grade of goods, Japan's 16 KDRAM accounted for about 40 percent of the U.S. market. The 16 KDRAM is a computer-use memory unit for which a huge market is anticipated hereafter, and because it is a pivotal premium item even among the

IC types, Japan's rapid assumption of leadership in this field posed a threat to the U.S. semiconductor industry, resulting in a political problem. In essence, it resulted in the requirement that Japan's market be opened by an early reduction to the final duty percentage (4.2 percent) at the Tokyo round, regarding duty on semiconductors, but on this aspect, considering the importance of maintaining and expanding free trade in the field of semiconductors, agreement was reached between the United States and Japan on 30 September 1981 for both parties to enforce early reduction during FY-82. With this action, both the United States and Japan will offer the most open markets in the world.

As described above, as far as the semiconductor industry is concerned, whether in technology interchange, investment interchange, or trade balance and duty, none of the issues contains any basic problem and the plan for a smooth trade promotion hereafter is anticipated. However, the development tempo of one phase of America's industry, particularly the sophisticated field, has been revealed to be in a lagging state when compared with Japan, and it cannot be denied that this condition can be fueled as a political issue and turn into a problem of trade friction. Serious attention must be given to this point.

The Present State and Policies of the World's Semiconductor Industries

United States

As the parent developer of the semiconductor element, the U.S. semiconductor industry enjoys a huge market, domestically accounting for about half of the world demand, and it has consistently been the world leader in the semiconductor industry. Although some quarters report that Japan has caught up recently, with respect to the power to develop new products, design technology, etc., the United States still has the capability of being number one in the world.

Ranking first in the world in semiconductor production is Texas Instruments, followed by Motorola, and including these two companies, many of the U.S. manufacturers have established marketing and production bases abroad. The IC shipments for all of the U.S.-affiliated companies totalled about \$6.4 billion in 1980, to supply 68 percent of the world IC demand.

America's IC imports totalled about \$2.8 billion in 1980, or 56 percent of America's domestic demand, but geographically an overwhelming total, 32 percent, was from Malaysia, Singapore and the Philippines combined. This is because recently U.S. manufacturers have established in Southeast Asian countries assembly plants which require laborers, and they have taken steps to return these assembled finished products to the United States. Incidentally, IC imports from Japan constituted 6.3 percent of America's IC demand in 1980, and among them were supply units for the United States made by U.S.-affiliated companies, such as Japan Texas Instruments.

It goes without saying that technological development in the United States is vigorously undertaken by private industries, but huge sums of capital

for development have been invested in large government projects in military, space and other areas. Recently the Department of Defense undertook a development project which is similar to Japan's VLSI development subsidy system, and it has projected the development of the VHSIC (very high-speed IC) with an investment of about $200 million during the 7-year period 1980 to 1986.

With the exclusion of in-house manufacturers, such as IBM and WE, the U.S. semiconductor industry can be classified into two groups; the small-medium and middle bracket "venture business" groups, such as Intel and Mostek, which are concentrated in the Silicon Valley region, and those that are independent of Silicon Valley such as TI. Of these, the "venture business" groups in Silicon Valley have received entrepreneurial benefits from new products derived from their ingenuity, but the trend is gradually moving in the direction of mass production and application with the attendant requirements of large capital funds and marketing strength. For these reasons, attention will be centered on the countermeasures to be projected by Silicon Valley hereafter.

There is no denying that the semiconductor industry in Europe has the appearance of lagging behind those of the United States and Japan. The major manufacturers are Siemens and Phillips, while the others are either U.S.-affiliated companies or joint venture enterprises. Europe's IC demand in 1980 was estimated at about $1.9 billion, of which about $1.5 billion was believed to be European shipments from U.S.-affiliated companies. Classified by country, IC demand was listed as 37 percent by West Germany, 21 percent by Britain and 15 percent by France, or a total of 73 percent accounted for by the three countries.

Semiconductor technology, especially IC technology, has made rapid progress, but because an enormous amount of human and financial resources are required, a great deal of time and manpower will be needed if the European manufacturers are to catch up with U.S. or Japanese manufacturers hereafter.

Future Outlook and Tasks

If the semiconductor industry is to progress to assume the nuclear role of truly supporting the foundation of Japan's industries, it is of paramount importance that it endeavor to step up its technological developments. Heretofore, the pattern has been basically to import items developed by U.S. manufacturers and to produce improved goods; in other words, consumer evaluation was based on superior quality management which was rooted in quality labor, and market acquisition resulted. However, should Japan further increase its competitive strength and assume a significant influential role internationally, and limiting itself only to those factors, then international friction will occur frequently hereafter and a substantive settlement cannot be achieved. To this end, the subject of elevating the world's semiconductor technology by emphasizing basic research and developing new elements with originality, thus contributing to the making of new products, is extremely important.

The idea of seeking coexistence with the rest of the world is considered essential from the standpoint of seeking the harmonious progress of the

industry, but for this, it is necessary to seek progress in internationalization from the standpoint of industrial cooperation. In this case, there are limits to the form, extent, etc., of cooperation by private industries, but to that end, a long-range view is desired. A number of semiconductor manufacturers has already been involved in on-site production, but seeking wide countermeasures in capital investment, technology contribution, third-country cooperation, etc., is anticipated hereafter.

As for demand, IC is used in standard products and customized products, and the bulk of today's production is in standard products. IC makes possible the miniaturization and multifunctional use of electronic equipment and it promotes mechatronics by its merger with machinery, and because of this, the fields of IC application will widen more and more hereafter and the trend is for fulfilling diverse needs. But because the emphasis is on a variety of goods with small production, today only a number of the medium-class manufacturers are fulfilling the demand, and a wide area of needs is left without fulfillment. In order to contribute to society in its entirety with the wide use of IC hereafter and the making of new equipment, it is essential that the semiconductor industry fulfill the need for custom IC through serious examination and execution.

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U.S. SILICON VALLEY SEMICONDUCTOR PRODUCTION ANALYZED

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[Special report: "Industries of the World--Electronic Equipment": Article by Yuji Kiyokawa, consul at the Japanese Consulate-General in San Francisco]

[Text] The technicians of Japanese companies in Silicon Valley watched the space shuttle launched gracefully into space and returned to the United States without any trouble, and they were made aware once again of America's electronic industry technology, especially the greatness of its sophisticated software.

Three staff members of an electronics company operating in a Middle Eastern country, a Frenchman, a Japanese and an American, were to be shot to death on a spying charge, and each was asked to voice his last wish. The Frenchman wished to sing La Marsellaise. The Japanese coolly stated his wish to give a speech on the ways of quality management, upon which the American shouted that he wanted to be shot first, before the Japanese spoke proudly on quality management which was for future generations! This is a joke written by Prof William Ouchi, writer of the book, "Theory Z," who was introduced recently in the prominent newspaper SAN JOSE MERCURY of Silicon Valley, and it is a meaningful joke to those recently connected with the electronics industry in America.

The total production of semiconductors in the United States is reported to be about $10 billion, and large production centers are located in the outskirts of Dallas, Texas, and the outskirts of San Jose, California, with the former popularly called Silicon Plain and the latter Silicon Valley. To the Japanese, the word "valley" suggests a picture of steep mountains and deep valleys with spring water from rocks flowing through, but to the large-scale Americans, who refer to Kyushu as Silicon Island, a large plain bordered by low mountain ranges in front and back is called a "valley."

Silicon Valley is a popular name given to the entire area in Santa Clara County, centering around Stanford University, which is about 80 km south of San Franciso; the 1,000 IC-related companies, both large and small,

concentrated in this area produce about half of the entire U.S. output. A great many of the giant electronic industry related companies, such as Lockheed and Hewlett-Packard, are located here, and the area ranks as the seventh largest industrial zone in the entire United States.

There are two reasons which account for the emergence of this huge electronic industry complex called Silicon Valley in this region. The first reason is Professor Thurman of Stanford University. Before World War II, he lamented the fact that the graduates all went to the East to seek employment, and his encouragement to them to establish "venture business" in the vicinity of the university was the beginning. For example, soon after graduation, young Hewlett and Packard responded to the encouragement, and in the beginning started their work modestly in the garage which is the origin of the world-famous Hewlett-Packard Co. The semiconductor technology at the outset began in the East, but Fairchild in Silicon Valley established it as a modern industry, and many of the executives of the principal companies in Silicon Valley today left Fairchild and established independent companies. Professor Thurman, who is still healthy, is called the "father of Silicon Valley." The second reason is the favorable natural conditions, such as cheap land prices, open area suited for industrial purposes and excellent weather with little rainfall. And especially for a topnotch technician to fulfill his dream of the future while enjoying a "quality life," it was essential that he be offered the opportunity to absorb knowledge of sophisticated technologies (at Stanford University), for job transferral and for the convenience of establishing "venture businesses" (with the headquarters of the many private companies), and indeed this became a heaven-sent land. In this manner, the valley still has ample possibilities for success in the future, and in fact, it is one of the few American "frontiers" with success stories abounding regarding the many "venture businesses." This is the land where not only Professor Thurman, but also Mr Hewlett and Mr Packard must be mentioned in the history of semiconductors, as well as builders of the valley rich in their individualism, such as Mr Noyce, Mr Moore, Mr Sanders, etc.; and then we must mention Mr Hiroe Nagafune, called the "father of Japan's semiconductor," and others, who have exerted all their energies to compete for innovations in the most sophisticated technologies and to succeed in their tasks with their devotion to ingenuity.

The Present State of the Semiconductor Industry

As is generally known, semiconductors, especially the recently discovered IC (integrated circuits, or chips as they are called in the valley) are components filled with circuits of several tens of thousands of vacuum tubes, placed on an area the size of the fingernail tip of the little finger; these were urgently requested by the U.S. Air Force and space officials for their small size and light weight. Just as reportedly almost all of the IC products mass-produced from 1961 to 1963 were purchased by the military and space agency, even today it is said that high-grade chips are indispensable for the latest weapons, such as the cruise missiles; it is difficult for outsiders even to guess at the facts of military-related activities because of the shroud of secrecy. To expand on this last

aspect, there are frequent reports on incidents of Soviet spying on technologies and of smuggling to communist bloc countries. It is reported that late last year the police and FBI launched an investigation into the theft of chips valued at about 600 million yen which were to have been delivered from Monolithic Memory Co to the Department of Defense and other agencies. At the same time, in the field of civilian goods, IC is called the "core of industries" and the "crude oil of future society"; by its incorporation into computers, office appliances, robots, automobiles and all types of machinery and equipment, it has assumed the principal role in the "information revolution" or the "second and a half industrial revolution."

The world semiconductor demand for the past 10 years, up to 1980, has continued to expand at a rate of increase of more than 20 percent per year. Along with the advances in miniaturization and cost reduction of semiconductors is the accelerated expansion of the electronic industry as users, and the scale of the world's electronic industry is expected to expand from $140 billion (about 31 trillion yen) in 1978 to $500 billion (about 110 trillion yen) in 1988, thereby attaining a scale that would rank alongside the petroleum and automobile industries, and for the semiconductor industry alone a scale of $50 billion (11 trillion yen) is forecast by the end of the 1980's. (A. D. Little Co)

Because of the many technical problems in the preparation of statistics on semiconductor production and consumption, it cannot be a complete accounting, but for all practical purposes, Table 1, prepared by the Semiconductor Industries in America (SIA), gives a global view of semiconductor production and a breakdown of consumers. According to this table, the value of U.S. semiconductor production in 1980 was $10.2 billion (2.2 trillion yen), of which less than 35 percent was exports, but because imports from Japan and other countries were included, its domestic consumption was $8 billion. Against this amount, the value of Japan's production was $3.6 billion (about 800 billion yen), which is about 35 percent of that of the United States; the figures also reveal that Japan's production scale slightly exceeds America's semiconductor exports of $3.9 billion. Considering that over half of America's semiconductors are produced in the valley, then the number of semiconductors produced in the valley far exceeds the total production for Japan. A listing of the principal companies in the valley and their shipping totals is shown in Table 2. There are some questions regarding the figures for Japanese companies listed in the table, but for comparison purposes, the figures are given in order to coordinate the data base. Regarding the U.S. semiconductor industry, outside the valley, the two preeminent companies are Texas Instruments and Motorola, and one can discern the industry structure with the presence of many mainstay companies in the valley. (Although IBM is the world's largest IC-producing company, it is not included in the table because its IC are utilized in its products and are not marketed outside.) With the enormity of the valley's electronic industry as a background, California accounts for 13 percent of the advanced technicians and scientists in United States, 20 percent of the electronic industry workers, 26 percent of the workers related to producing electronic computers and 35 percent of the semiconductor industry workers.

Table 1. World's semiconductor production and consumption matrix (1980)

表1 世界の半導体生産と消費マトリクス (1980年)

(1)(単位：億ドル)

(11) 消費国 / (2) 生産国	(3) アメリカ	(6) ヨーロッパ	(7) 日本	(8) その他	(12) 生産総計
(3) アメリカ	73	21	4	4	102
(4) (外販)	(55)	(21)	(4)	(4)	(84)
(5) (自社消費)	(18)	(—)	(—)	(—)	(18)
(6) ヨーロッパ	2	14	—	3	19
(4) (外販)	(2)	(12)	(—)	(3)	(17)
(5) (自社消費)	(—)	(2)	(—)	(—)	(2)
(7) 日本	5	2	27	2	36
(8) その他	—	—	—	4	4
(9) 消費総計	80	37	31	13	161

資料：SIA (10)

Key:

1. Unit: $100 million
2. Producing countries
3. United States
4. Marketed
5. Used by own company
6. Europe
7. Japan
8. Others
9. Consumption total
10. Data by SIA
11. Consuming countries
12. Production total

Table 2. Semiconductor shipping totals for Silicon Valley and Japan's major companies

表2 シリコンバレー及び日本の主業企業の半導体出荷額 (1980年)

(1)(単位：百万ドル)

(2) シリコンバレー		(13) 日本	
ナショナル (3)	770	日本電気 (14)	769
インテル (4)	575	日立 (15)	658
フェアチャイルド (5)	570	東芝 (16)	629
シグネテックス (6)	391	富士通 (17)	424
AMD	282	松下 (18)	300
AMI	115	三菱 (19)	254
レイセオン (7)	65	沖 (20)	NA
シリコニックス (8)	65	(21) (参考) 非シリコンバレー (22)	
インターシル (9)	175	テキサスインスツルメント (23)	1,580
モノリシック・メモリーズ (10)	88	モトローラ (24)	1,100
シナーテック (11)	70	モステック (25)	330
ザイログ (12)	35	RCA	322

資料：DATAQUEST Inc. 1981年5月 (26)

[Key on following page]

Key:

1. Unit: $100 million
2. Silicon Valley
3. National
4. Intel
5. Fairchild
6. Signetics
7. Raytheon
8. Siliconix
9. Intersil
10. Monolithic Memories
11. Synertek
12. Zilog
13. Japan
14. Nippon Electric Co
15. Hitachi Ltd
16. Toshiba Corporation
17. Fujitsu Ltd
18. Matsushita Electrical Industrial Co Ltd
19. Mitsubishi Electric Corp
20. Oki Electric Industry Co Ltd
21. Reference
22. Not in Silicon Valley
23. Texas Instruments
24. Motorola
25. Mostek
26. Data by Dataquest Inc, May 1981

Distress in the Valley

In the past, America's semiconductor industry achieved an annual growth of more than 20 percent, but starting in the latter half of 1980 it has experienced a slump in demand resulting in overstocking due to users paying unusually high interest, a decrease in demand for civilian goods such as electronic games, a sharp decrease in prices, etc. At the end of 1980, it was estimated that the bottom of the slump would occur in the first quarter of 1981, and Rosen Research, a leading survey company, predicted that the shipping volume in 1981 would be 5 percent lower than in the previous year and that the shadow of the slump would be strong for the succeeding period. Even recently the prevailing view has been that it would be unreasonable to expect a recovery of business in the first quarter of this year. As a result of the slump, the various companies in the valley have curtailed operations and enforced compulsory leavetaking in a mood of depression. During the previous slump, in 1974, layoffs and reduction in investment in facilities occurred, and the result was a bitter experience, for with the turn to good times the lack of supply power led to the advance of Japan-made semiconductors into the U.S. market. And so with this slump, because the various American companies have avoided laying off and have continued to invest in facilities, taking a long-range view even without a forecast of the future, the press has asked: "Are those in Silicon Valley heroes or lemmings?" (creatures who blindly drive themselves to suicide). But finally, in late October of last year, it was sensationally reported that the AMD subsidiary company, Advanced Microcomputer Co, made the bold move of laying off 193 employees, and other companies postponed plans to invest in facilities or took action to reduce operations. The unusually high interest rate in the United States began dropping in the latter half of 1981, but the economic situation overall has taken a turn for the worse, and it is feared that the semiconductor industry will undergo a deeper slump in the future.

Japanese Companies in the Valley

Because of the deep economic and cultural ties between the United States and Japan and with the valley being the center of the U.S. semiconductor

industry, the valley has become the most suitable place for transportation and communication with Japan, for which reason most of Japan's semiconductor companies have engaged in production and operations here. With the exception of the oldest firm, Roma Co--formerly the Toyo Electrical Manufacturing Co, a middle-ranking IC manufacturer which in 1971 established the Exar Co (president; Kenichiro Sato) in the valley for semicustom IC production and which has a successful 10-year history, a labor force of 300 employees and sales of $25 million--the history of Japanese companies in the valley is comparatively new. The Nippon Electric Co Ltd has its NEC Electronics Co (president, Hiroe Nagafune) in the valley as its base for all U.S. operations and the Electronic Arrays Co (purchased in 1978) as its production base. At the time of purchase, the labor force was 289 employees and the sales total was $15 million, and it was not a sure profitmaker, but today with 400 employees and a sales total of $40 million, it has improved to a state of being profitable. The company's basic policy is to strictly remain an American company that will contribute to its regional society and that will produce locally more than half of the Nippon Electric sales items for the American market. As a part of its long-range plans, its second factory will be located in the so-called second Silicon Valley. The company announced last year that it would build in Roseville, situated on the outskirts of Sacramento, with an investment of $100 million, and ultimately it intends to build a factory that will not be inferior to the company's plant in Japan. The Toshiba Corporation in 1980 purchased the Maruman Integrated Circuit Co, an enterprise of Americans of Japanese descent, and renamed it the Toshiba Semiconductor Co. After about 1 and 1/2 years of expanding its scope and increasing its personnel, its labor force has increased from 230 at the time of purchase to the present 380. It is ready to operate smoothly under the strong leadership of President Kenji Takahashi and it expects to ship annually a total of about 10 billion yen worth of goods, all to be delivered to Toshiba America Co. The company already has become an integral part of the valley's semiconductor community and as the occasion arises, it has engaged in the mutual use of facilities with American semiconductor companies. In contrast to these three companies being located in the valley, the Fujitsu Microelectronics Co (president, Matami Yasufuku; vice president and executive officer in America, Yutaka Sugiyama), although it has plans to have its base of operations in the valley, in 1979 began the construction of an IC factory with a capital of $10 million in San Diego, near the Mexican border, and in June 1981 it held the factory's inauguration ceremony. At the outset, the factory had a labor force of about 150 employees, but in 1 or 2 years the company expects to increase it to about 400. By producing in America all that it intends to sell on the U.S. market, the company strongly hopes to contribute to solving the problem of IC trade friction.

Besides the above companies in the valley, Japan's major semiconductor companies, such as Hitachi America (business manager, Eiji Kogu), Mitsubishi Electronics·America (business manager, Rempei Tsuchiya), Oki Electric (office manager, Tatsuo Ishihara) and Sanyo Semiconductor (business manager, Tsuyoshi Taira), have successively established operational bases and other facilities, and the extent of increase of Japan's semiconductor related companies is so great that recently the NEW YORK

TIMES referred to the grouping as "California Tokyo." In this respect, the advance of American semiconductor companies into Japan has followed practically the same pattern, and it can be said that it is in a transitional stage from a simple trade relationship to one of mutual extension. And the actual status is that, while there is an intense competition between the semiconductor companies of the United States and Japan, at the same time there is procurement from a rival competing company if a superior semiconductor is developed, and as some reporters have described it, it is not a simple relationship where competing rivals cannot exist alongside each other.

Such a manner of writing may convey the impression that everything is progressing satisfactorily, but the truth is that all the companies are struggling through difficulties. In 1977 and 1978, not only the local papers but even FORTUNE magazine carried unpleasant illustrations and articles, entitled "Japanese Spies in Silicon Valley," as if there were a "U.S.-Japan Semiconductor War," and as will be described later, various efforts were exerted in order to reach the present state. Even with plant management in America, in an operational environment that differed in every respect from that of Japan and of hiring practices that differed and were symbolized by a high rate in change of occupations, there was a process of trial and error in establishing better mutual understanding from unfamiliar English spoken by employees of various ethnic backgrounds. Moreover, the children of employees sent from Japan encountered difficulties; even after study, upon returning to Japan, the system to receive the student returnees was in name only and often there were no guarantees regarding the future of the children, thus leading to lowering the morale of the employees. Besides, the unitary tax (the aggregate tax system) of California recently has become a big stumbling block to investments in America and has been viewed as becoming an increasing problem. Although these various companies, enduring hardships too numerous to mention, along with Consul General Hiroshi Kitamura are doing their best to dissolve any trade friction and to dispel any misunderstanding toward Japan, by taking up the problem elsewhere and without visiting the area directly, a leading Japanese newspaper made an unfounded report to the effect that "intertwined with the valley's semiconductor problem is the stoning of Japanese children," which greatly angered those concerned. Considering the history of the rejection of Japanese immigrants from California as one of the remote causes [as published] of World War II and considering the fact that racial discrimination today in the United States is prohibited by law, it goes without saying that with this sort of sensitive problem, judicious reporting based on facts is desirable.

U.S.-Japan Semiconductor Relations

The U.S.-Japanese relations in the semiconductor industry at present are in a lull. The sharp charges against the Japanese, principally by the SIA around 1978, were spectacularly reported as the "U.S.-Japan semiconductor war," but, although the 14 December 1981 issue of FORTUNE magazine reported that the Japanese companies account for 69.5 percent of the world's share in the production of the 64 K RAM and that Silicon Valley has been far

outdistanced by Japan in sophisticated technology chips, the article is very objective and scientific, written with dignity when compared with the yellow journalism of the former spy accounts.

The biggest reason for the present state of stability in U.S.-Japan relations is believed to be the move for the early tariff reduction on semiconductors announced by Prime Minister Suzuki during his visit to the United States in May of last year. It was agreed at the Tokyo round negotiations that the semiconductor tariff (12 percent for Japan and 6 percent for the United States) of both countries would be reduced to 4.2 percent in 1987, but because of the conspicuous rise subsequently in the competitive strength of Japan's semiconductor industry, cries of opening Japan's markets without delay by lowering the tariff were raised principally by the SIA, and this became the SIA's major demand with regard to Japan. However, Japan quickly accepted the demand and agreed to reduce the tariff starting early this year to 4.2 percent for the United States (4.2 percent also for next year) and 4.2 percent for Japan. (Europe has maintained its high tariff of 17 percent, and both the United States and Japan are asking Europe to follow suit in the move for reduction.) It was deduced from press accounts that Prime Minister Suzuki's announcement on the move for early reduction was greeted with favorable comments, but now that trade barriers have been removed, with Japan accepting SIA's demand to open up markets, whether the Japanese market can be penetrated will depend on the amount of effort expended by the individual companies hereafter. Another point that must be observed is the "quality management seminar" that was sponsored by the Electronic Industries Association of Japan in Washington, D.C., in the spring of 1980. At the assembly, Hewlett-Packard Co, a giant user of semiconductors, revealed a comparison of results of tests with both U.S. and Japanese semiconductors, and the fact that the quality of Japanese semiconductors was reported to be remarkably superior not only served to sweep away the image that the market share was gained by dumping exports of Japanese goods, but it became the opportunity to establish an image that "Japan equals quality management," which was the crux of Professor Ouchi's joke mentioned in the opening paragraph. Also, a joint research into the U.S.-Japan semiconductor industries, led by Professor Takuo Sugawara of Tokyo University and Professor Linville of Stanford University, was conducted for nearly 2 years with many scholars and researchers recruited from the United States and Japan. It is noteworthy that the course of this slow but sure research did not stop simply at semiconductors, but went into survey and research on such broad fields as the politics, economics, financial systems, tax systems, industrial fields, etc., of both countries, and it is believed that it is an invaluable asset for the future.

In addition, as a more basic issue, one cannot overlook the fact that, because U.S. semiconductor companies have invested in Japan and engaged in production leading to an increase in the number of cases of exporting the products to the United States, any criticism of importing semiconductors from Japan in essence is a criticism of American companies. The increase in American companies investing in Japan hereafter should all the more reduce the feeling of dissatisfaction by American companies on the

trade issue. But it should be noted that investments by private companies in Japan will inevitably lead to a greater demand for equal treatment with Japanese companies, or treatment like a native company, from the standpoint of Japanese Government measures; theoretically, the demands will get greater, just as the U.S. banks in Japan are currently demanding not only "no discrimination" treatment from the government domestically but also reciprocation in all aspects of the treatment granted to Japanese companies in the United States.

At any rate, the present demands on Japan by the SIA, organized by the valley semiconductor manufacturers, are twofold. First, as mentioned in the report of the U.S.-Japan Wise Men's Group, the early reduction of the semiconductor tariffs of the United States and Japan to 4.2 percent, the abolition of the tariff on technologically sophisticated industries in the future, and the granting of equal treatment as pertains to governmental R & D plans and government procurement. (The extent of these two aspects is described in the report containing the requests by SIA to the Wise Men's Group.) Second, the SIA's plan to have Japan cooperate in compiling semiconductor trade statistics inclusive of the United States, Europe and Japan.

The Latent Power of the United States.

American journalism for the past year has played up Japan's overwhelming superiority in production technology by describing the high reliability and superior quality management of Japan's semiconductors and the advanced 64 K RAM. But the technicians of Japanese companies in the valley had a firsthand observation of the smooth launching of the space shuttle "Columbia" with complete computer control and its return to America with no problems whatsoever, and were made aware once again of the might of America's electronic industry technology, particularly its superior software. Furthermore, in 1978 the Department of Defense announced an R & D plan for VHSIC that would have a speed and capacity 100 times that of today, and work has been underway since 1981. This sort of military technology falls in the realm of defense secrets, and outsiders cannot even guess at it, but it is clear that in time the results will become commercial spinoffs. Contrary to some reports, the members of the U.S. electronics industry are deeply confident of themselves. Although Japanese companies excel in some varieties of semiconductors, the United States has overwhelming superiority in semiconductors as a whole, and actually there has been no change in its market share in the world. A good example is Motorola Co, which ran a series of "testimonial" advertisements entitled "Responding to Japan's Challenge" in the major trade journals starting last August, and in them it gave concrete explanations of the company's excellence in the American way of life today, even when Japan has outstanding electronics products, and it served to stir up the various American companies.

The semiconductor industry is an industry of rapid technological innovations and at the same time one in which the benefits for the innovator and benefits regarding scale are very marked. According to the "Theory

of the Running Curve" which has been adopted by Texas Instruments, if the production volume is doubled, the cost is reduced by 27 percent. In other words, if the production volume of semiconductors, which presently is in a state of balance in income and expenditure, is doubled, a profit of 27 percent will be realized, but once a new technology is brought into mass production by the innovator, it is impossible for the subsequent producing company to compete regarding cost, and in fact it cannot enter the market. This theory emphasizes that in business competition the size of operations determines the winner, and today in the valley, with the exception of a few, the medium-size companies have been abosrbed by giant companies during the past few years. With this sort of trend in the semiconductor industry, surviving as the leaders in the semiconductor industry in the future will be five or six companies throughout the world, while the others may continue only as custom manufacturers fulfilling orders with specifications requested by a client, in the opinion of some influential quarters.

Challenging technological innovations is essential in order to survive, but Americans believe that because of the differences in culture, education and business operating methods between the United States and Japan, the Japanese can absorb ideas and have the capacity to excel in thorough production, whereas Americans can tinker with original ideas and excel in developing innovations. The counterargument that the purchase or other disposition of patent rights and knowhow in the course of catching up technologically can be considered in this sort of discussion, but in any case, whether the perception on the cultures of the United States and Japan is right or not will probably be known as a fact in the very near future.

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